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Use of Soft Systems Methodology in the Evaluation of a Business-Government Digital Initiative in New Zealand Schools

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Abstract

Generation XP was one of the four Digital Opportunities pilot projects carried out in partnership between the New Zealand government, schools, businesses and Maori organizations between 2001 and 2003. One aim of the projects was 'to help bridge the digital divide' between students from low-income families and of varied ethnicities, and other students. Other aims were to trial the concept of public-private partnership in ICT education and to learn lessons which might be useful in the design of new initiatives. The present paper describes the author's experience in the application of Soft Systems Methodology in evaluating the Generation XP project.

Keywords

Soft Systems Methodology

ICT Education

Microsoft Office Specialist

Public-Private Partnerships

Digital Opportunities

Digital Divide

INTRODUCTION AND BACKGROUND TO THE PROJECTS

Generation XP was one of four Digital Opportunities projects set up in New Zealand in 2001. The projects were established as partnerships between government, business and schools. They had the general aim of 'bridging the digital divide.' In other words they had 'an overarching goal of raising student achievement and improving student participation,' especially in school catchments where access to adequate ICT infrastructure had been limited.

The particular focus of the Generation XP project was clearly to 'bridge the gaps', of ICT access, ability and attitude between students in higher and lower decile[§] schools, and to lower infrastructural, socio-economic and geographical barriers to student achievement and participation, especially in relation to technology skills and qualifications. West Auckland and Gisborne, on the east coast of the North Island were selected as two districts in which such barriers were felt to exist. The project's goal was to provide Microsoft Office training leading to internationally recognised Microsoft Office Specialist (MOS) qualifications to senior secondary students. This was done by face-to-face teaching in the schools. Students were assessed on line via the US based Certiport facility. Official MOS course books were provided, and teachers received training to deliver the courses. A secondary goal was to register the qualifications with the New Zealand Qualifications Authority (NZQA) so that credit for achieving them could be counted towards the New Zealand Certificate of Educational Achievement (NCEA).

Four secondary schools were chosen in each district, with decile ratings between 2 and 5. The Auckland schools were characterised by diverse student populations which included Asian, Pasifika, African, Maori and Pakeha (New Zealand European) ethnicities. Students studying the courses in one Auckland school included 41% Pakeha, 30% Pasifika, 14% Asian, 9% Maori and 6% Other. This latter category included students with African and South American backgrounds. By contrast, the population of Gisborne has a high percentage of indigenous Maori. The students studying the courses at one Gisborne school included 52% Pakeha, 41% Maori, 3% Pasifika, 1% Asian and 3% Other. Two schools in each location were single sex. One (with the highest decile rating) was an integrated Catholic foundation. The two single sex schools in Gisborne made the courses compulsory for almost all Year 12 students, whilst other schools made them optional. Courses were either taught as stand alone courses or integrated (to a greater or lesser extent) with pre-existing courses leading to NZQA Unit Standards.

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[§] In New Zealand, the decile rating of schools is used to reflect the socio-economic status of the school community. Decile ratings run from 1 to 10, with 1 being the lowest.

Business partners involved in the Generation XP project included Microsoft, IBM, TelstraClear, and BCL. Microsoft was the lead partner and appointed contracting organizations to carry out various aspects of the pilot, including project management. The business partners provided the pilot schools with a minimum of 128K bandwidth, hardware and software, staff training and courseware related to MOS and other Microsoft qualifications; and access to the Microsoft examinations through the Certiport portal. There was also a communication facility provided by the Learning Centre Trust as part of the Te Kete Ipurangi (TKI) website.

The pilot had specific evaluation aims. These covered:

- Studying the effects of the courses on raising students' achievement levels and on study and employment choices
- Assessing robustness and sustainability of the ICT infrastructure
- Assessing the impact of professional development offered to staff
- Documenting the process of registering the qualifications on the National Qualifications Framework

There were themes common to Generation XP and the other Digital Opportunities projects, especially relating to sustainability and robustness of the projects. These led to the following research questions:

- To what extent, and under what conditions, did the stakeholders regard the project as sustainable in the pilot schools beyond the pilot phase?
- What lessons have been learned from the pilot that could usefully inform any roll out of the scheme out to other schools and other school districts?

The approaches to data collection were multi-method within the general methodology of a multiple case study. Data was obtained from a range of sources including questionnaires, interviews, student records, logs of website access and documentation from official sources.

Some time into the project, the evaluator was reviewing the data and was considering how best to approach the two research questions given above. The project appeared to be complex and '*messy*,' and the evaluator was unable to find a body of relevant literature describing similar projects. He recalled being introduced to systems thinking some 20 years earlier, and, after renewing his acquaintance with Soft Systems Methodology (SSM), decided that this could be a promising approach. The present project presented specific problem areas, such as those related to student recruitment and retention, and to teacher training and professional development which seemed amenable to treatment using the logical analysis stream of SSM. In addition, the project involved complex cultural and political situations, in which the cultural stream of SSM was perceived to be of potential value. Accordingly, the author used SSM as described by Checkland (1984), Checkland and Scholes (1999), Davies and Ledington (1991), and others. The rest of this paper describes his application of the methodology and his experiences of its use.

LITERATURE REVIEW

The Digital Divide

Various authors have discussed the nature of the digital divide. See, for example Warschauer (2002). The concept of '*digital divide*' was originally taken to indicate inequalities of access to ICT infrastructure. Over time, this interpretation was increasingly regarded as being too simplistic. The concept was broadened to include barriers of '*access, ability and attitude*.' This view of the digital divide was adopted to underpin the Digital Opportunities projects.

Subsequently, it became clear that the digital divide was considerably more complex, if indeed the term had any real meaning. In an educational setting, for example, it is important for students to have access to ICT, the ability to use it, and a positive attitude towards it. However, it is even more important that ICT is used appropriately and creatively to support student learning. (Ham et al 2004) These considerations have led to the downgrading of the criterion '*bridge the digital divide*' in the second round of Digital Opportunities Projects in New Zealand. (NZ Ministry of Education (2004))

Generation XP

The author was unable to find a body of literature on the evaluation of in-school ICT training initiatives similar to Generation XP. There also appears to be little literature evaluating the effectiveness of conventional school based teaching of students to use Microsoft Office or similar software.

Soft Systems Methodology

Soft Systems Methodology was originally developed by Checkland (1984). It has been further discussed by Checkland and Scholes (1999), Davies and Ledington (1991), Travis and Venable (1999), Dick (2002) and others

The so called '*developed form*' of SSM (Checkland and Scholes (1999)), involves both a '*cultural*' and a '*logical*' stream of analysis. The cultural stream considers the social and political contexts of the situation being analysed. It is important because suggestions for improvement of the situation have not only to be logically desirable, but also need to be acceptable to the people and organizations involved in the situation.

The logical stream of analysis, as described by Checkland (1984) follows a seven step procedure. A clear diagram of the procedure appears on page 11 of Davies and Ledington (1991).

In this model, which was adopted as a starting point in the present analysis, the first stage represents a mass of unsorted data about the situation, such as that amassed by the author during the course of the evaluation. Stage 2 consists of imposing some order on the mass of data so as to identify key issues and themes. It is usually carried out by creating a Rich Picture (RP) of the situation. The RP is useful to help identify problematic areas in the situation. Problematic areas whose improvement is considered to be key to improving the whole situation are chosen to develop systems for modelling in the logical stream of enquiry. As well as being useful in the logical analysis, the RP can serve as a starting point for the cultural analysis.

Steps 3 and 4 of the logical analysis involves moving from the '*real world*' situation into '*systems thinking*.' Here model systems are developed which, if implemented, could lead to improvements on the real situation. In general, it is not anticipated that the model systems would actually be implemented in the real world. Their creation is intended to stimulate dialogue with stakeholders leading to action in the real world to improve the situation. In step 5, the dialogue begins as the models are compared with the existing real world situation. The dialogue continues in step 6, and would bring in considerations highlighted during the cultural analysis of the situation. The model culminates in Step 7, in which action is taken to improve the situation. From this point, the cycle could be repeated.

Dick (2002) has described the application of SSM as a four stage dialectical process. Dick's model involves the nature of the actual situation, the essence to be captured in root definitions, the expression of ideals in the form of conceptual models, a dialectic between the ideals and reality as explored in the development of action plans; and the dialectic between these plans and the implementation of changes. In the present study, the procedures outlined by Checkland and Scholes (1999), and by Davies and Ledington (1991) were used as a guide, but the actual process involved considerations as outlined by Dick.

THE APPLICATION OF SSM TO THE PROJECTS

Rich Pictures

Consideration of the climate of the pilot projects and the data collected from the various sources allowed the evaluator to draw rich pictures encapsulating the climate, tasks, relationships and issues. In line with Checkland's (1984) practice, these pictures were hand drawn and revised throughout the course of the evaluation. The following Rich Picture (RP) (Figure 1) of the Generation XP pilot is an edited version of a larger RP which was developed during the life of the project.

The situation involved many stakeholders, each with its own worldview and agenda. They involved technical, planning, communication and relationship issues. There were also factors involving issues of power and control.

Some issues which all the Digital Opportunities pilots had in common were related to the nature of partnerships between government, schools and businesses, issues of targeting appropriate participants, and those relating to problems with hardware and software and getting them remedied. Schools were also concerned about how to continue to fund the innovations once the Digital Opportunities support ended. A specific concern of schools involved in Generation XP related to the suitability of the MOS curriculum and course materials for New Zealand students.

The rich picture was used to help generate a cultural analysis of the situation. It was also used to help identify areas for possible improvement which were modelled in the logical analysis.

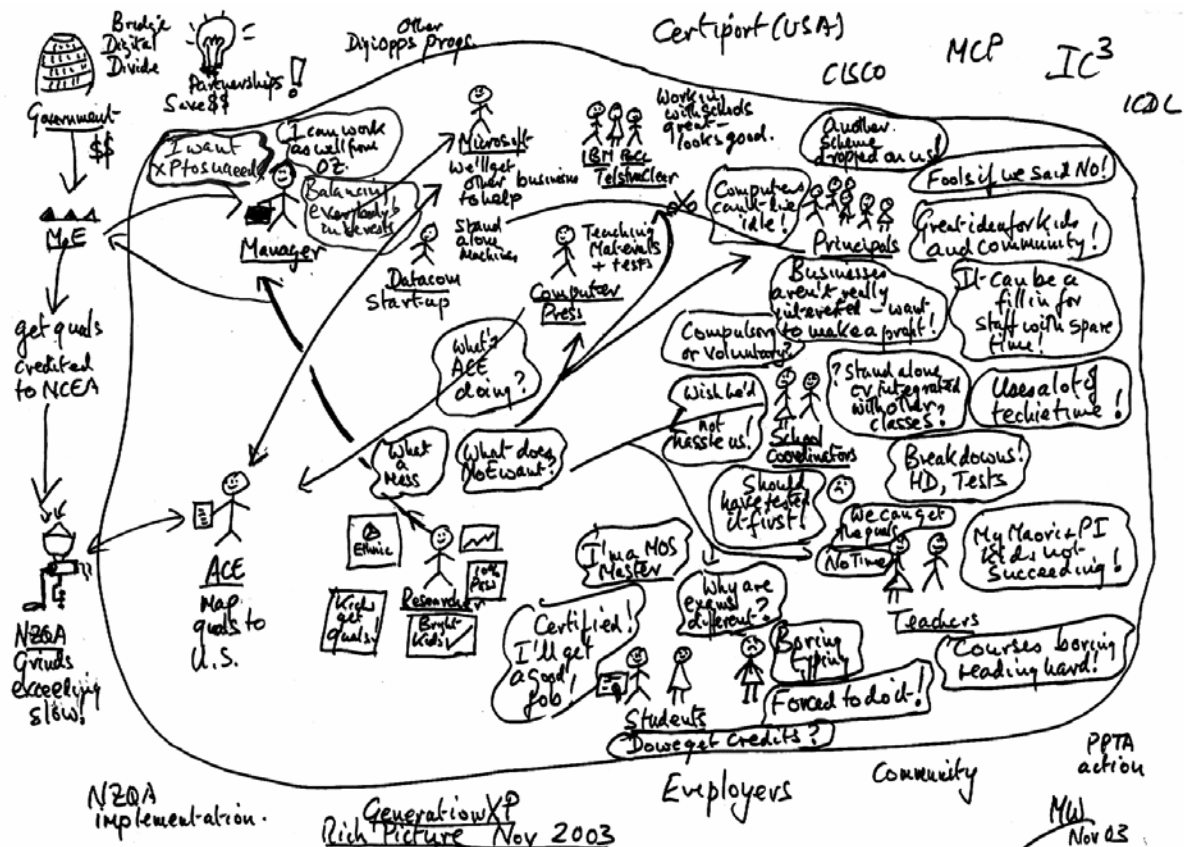


Figure 1. Rich Picture of the Generation XP Pilot Situation.

Cultural Analyses

The project represented a meeting of at least three different types of culture – business, schools and government. The project also generated its own subculture. Analysis of the cultural aspects of the project was important to indicate which suggestions for improvement from the logical analyses were likely to prove acceptable to the stakeholders. The cultural analysis followed the suggestions of Checkland and Scholes (1999).

In considering the *Role Analysis* of the project, the client for the analysis was the Ministry of Education, who had commissioned the evaluation research. The Ministry, and schools were also ‘*would be problem solvers.*’ The Ministry had indicated an interest in the sustainability of the project, in improving outcomes and in rolling out the projects; and schools had interests in sustainability and in improving programme outcomes for their students. Microsoft Ltd and its contracting companies were interested both in improving outcomes of the project, and in rolling out the project to other schools. ‘*Problem owners*’, those who had power to curtail the project at some level or other included the Ministry, who had the power to cease supporting the project, and principals, who had the power to withdraw from the project. In the event, the Ministry continued to support the project to the end of their planned life, but schools had to make their own arrangements to finance them during 2004. Microsoft Ltd was also a problem owner. It could cease to support the project by, for example, ceasing to sponsor student MOS examination costs. It is the author’s understanding that examination costs continue to be subsidised in 2004.

Social Analysis of the project involved considering the *roles, norms and values* of key players. The project involved the Ministry of Education, which appointed a single manager to run all four Digital Opportunities projects. The Ministry carried out policy regarding setting up the project and establishing the partnerships. However, in this, as in the other projects, there was a clear feeling from the schools that the project did not represent a ‘*true*’ partnership in that schools were not involved in the establishment and planning of the project, and felt ‘*dumped on.*’ In fact, the Ministry had been constrained by the political process to maintain confidentiality about the projects until they were officially announced in February 2001. This resulted in a

telescoping of the time course for selection of schools and implementation of the project and made it impossible to involve schools in the early planning process. Schools also had expectations regarding the ongoing nature of the partnership, such as ongoing contact with and interest from business partners, which differed from what actually occurred.

The social analysis of the project also highlighted differences in schools' commitment to making the pilot succeed. Successful schools were those which established and maintained suitably committed, trained and qualified staff to run the projects. They also ran courses as electives for the students and publicised them effectively within the schools.

Political Analysis of the project, which considered how power was wielded, showed that power relationships at the higher levels of the project were reasonably straightforward. Power relationships at the lower levels in the project seemed relatively straightforward in the more successful of the Generation XP schools. However, some less successful schools failed to provide adequate staffing or technical support for the project. Communication was lacking, courses were made compulsory and students resisted studying them. Consequently, few students took the examinations in these schools.

Logical Analysis

In Soft Systems Methodology, the '*logical analysis*' is undertaken to develop idealised model systems designed to improve specific aspects of a problematical situation. These models are not intended to be built in real life. Their function is to challenge thinking on the way to improving the real situation by being contrasted with the reality of the actual situation. Thus they exist to stimulate dialogue and debate as to the way forward.

Due to the author's relative inexperience in using SSM, the logical analysis was started using the seven-step framework proposed by Checkland (1984). With increasing familiarity with the method, the author became more flexible in his use of the methodology.

Choice of Model systems

The Rich Picture and Cultural Analysis of the project made it easier for the evaluator to make sense of the data and his impressions of the project situation. Following Davies and Ledington (1991) he identified 8 problematic areas in the Generation XP programme. These were divided into issue and task based areas. They led to 10 candidate aspects which could be modelled. Of these the systems listed in Table 1 were actually modelled.

System Modelled	Task or Issue Based
A Teach/Learn/Test System	Task
Student Recruitment and Retention System	Issue
Teacher Training and Professional Development System	Task
Fruitful Partnership System	Issue

Table 1. Systems chosen for modelling.

The task of teaching the students effectively so that they gain knowledge and achieve the MOS qualifications was crucial to the success of the project. In order to do this effectively, it would be essential to train teachers appropriately and to provide them with ongoing professional development. One goal of the pilot was to target students from particular ethnic or socio-economic groups. This was not done very effectively in the pilot, and hence the issue of student recruitment and retention was chosen as an area to model.

Parallel issues relating to the nature, establishment and maintenance of partnerships between schools, business and government were seen as important, at least by schools in other Digital Opportunities projects.

Root Definitions and Conceptual Models

Development of *root definitions* and *conceptual models* are stages 3 and 4 in Checkland's (1984) seven step model of, SSM, and constitute part of *systems thinking*. Root definitions of the six chosen systems were written in the form '*a system to do X by means of Y in order to achieve Z.*' (Checkland and Scholes (1999)). The mnemonic CATWOE was used in writing the root definitions to check that all relevant criteria had been included.

The author was also involved in the evaluation of another Digital Opportunities project. It turned out that the partnership systems developed for both pilots were quite similar, reflecting the fact that similar partnership issues emerged in both situations. The Generation XP partnership system will be used to illustrate the process of developing root definitions and conceptual models. Table 2 shows the root definition and CATWOE for this system

A system to establish and maintain fruitful partnerships between schools, Ministry (MoE) and businesses by identifying potential partners, defining the scope of the partnerships, establishing working relationships between the parties, defining roles, responsibilities, accountabilities and monitoring procedures and establishing regular communications and defining scope and nature of the partnership in order to facilitate the establishment and running of the Generation XP project and to ensure that all partners appreciate each others concerns regarding the project.	
Customers	Schools, businesses MoE
Actors	Schools, businesses, MoE
Transformation	Organisations and individuals ignorant of each others' world views working in isolation from each other and pulling in different directions → A cooperative team of entities aware of each others worlds and issues, working together to create greater ongoing success of the programme
<i>Weltanschauung</i> (World View)	It is beneficial to the programme and more efficient for these entities to work in real partnership than in isolation. New Zealand is too small a country for people not to work together
Owners	Schools, BPs, MoE
Environment	Need for digital projects to succeed if NZ is to be competitive in a digitised world Financial constraints due to small size/budget in NZ. Need for disadvantaged sectors to succeed.

Table 2. Generation XP Fruitful Partnership System Root Definition.

In this root definition, the people who would benefit from establishment of a viable, ongoing partnership (*Customers*) are the stakeholder organizations who would also be the *actors* involved in carrying it out. They would also be the *owners* in the sense that they would have the power to dissolve the partnership A viable partnership would transform a heterogeneous group of individuals and organizations into a cooperative team. The *worldview* makes the establishment of a partnership worthwhile, and the *environment* indicates the context in which the partnership system would be relevant.

Similar procedures were followed to develop root definitions of the other systems. The process was found to be quite intellectually demanding. In some systems, such as the student recruitment and retention system, particular aspects of CATWOE proved challenging to identify

The process of developing conceptual models, which were designed to model the processes carried out by the systems described in the root definitions, followed the procedure outlined by Davies and Ledington (1991). Key activities from the root definition for a particular system were identified and arranged in logical order by defining the activities' dependencies on each other. For example in the partnership root definition, establishing relationships between prospective partners depends on their being identified first, and defining members' roles and responsibilities depends on the definition of the scope of the partnership.

The next step was to draw a diagram modelling the system. The conceptual model of the Generation XP fruitful partnership system is shown in Figure 2. The upper portion of the diagram involves five activities, from *identify partners* to *set up regular communication* models the activity system. There are two further activities, *research likely partners* and *solicit involvement*. These activities clearly emerged as necessary prerequisites to the main activities whilst the conceptual model was being constructed. The line surrounding these seven activities represents the system boundary. Factors in the environment which affect the system are indicated outside the system boundary.

The lower set of activities – *establish performance criteria* through to *monitor all activities* make up a monitor and control subsystem. The function of this is to check the performance of the activity system against internal and external criteria, including time and financial constraints.

A similar procedure was followed to develop root definitions and conceptual models for all the activity systems listed in Table 1. The process proved to be very useful in clarifying logical sequences of activities in the systems studied. It was also very effective in identifying activities necessary as prerequisites to the main sequence of activities. For example, in the *Student Recruitment and Retention* system, prerequisite activities included involving Maori and Pasifika communities in the regions in which projects would be established, and using young role models to promote the courses.

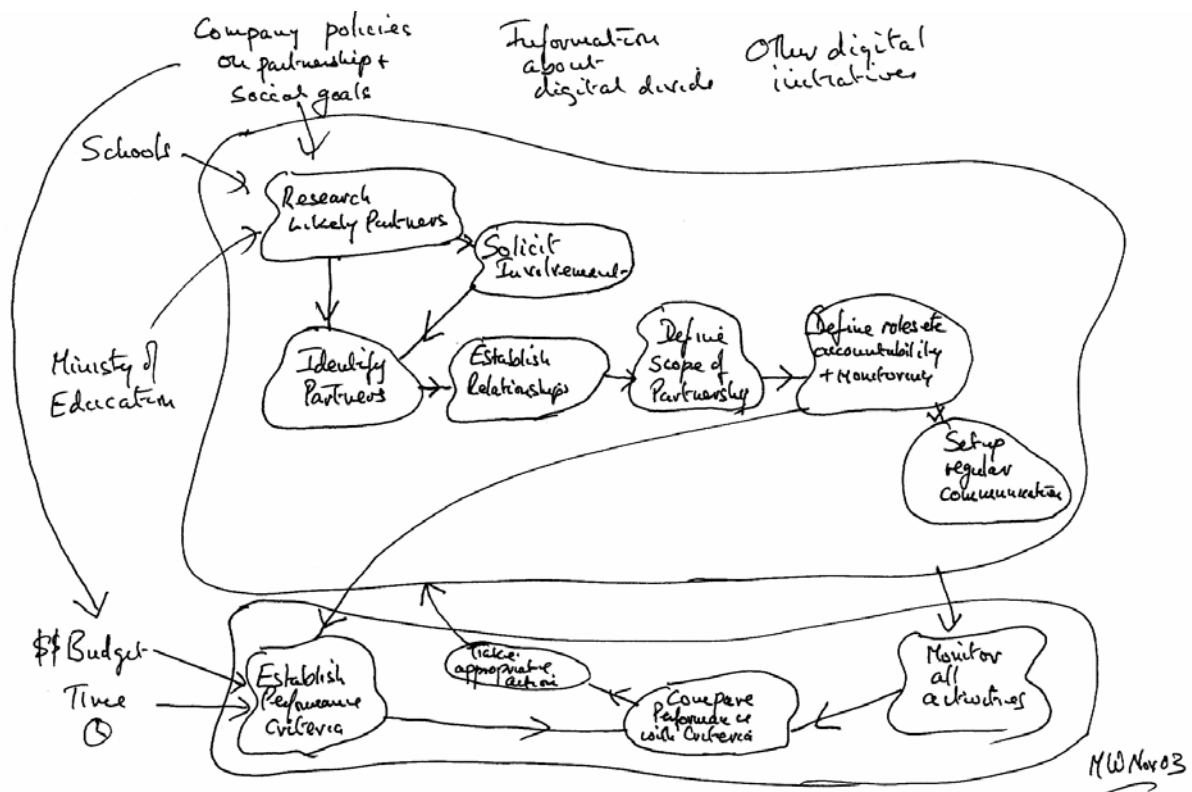


Figure 2. Generation XP Fruitful Partnership Conceptual Model

Suggestions for Improvement

The seven-step model of Soft Systems Methodology includes comparison of conceptual models of systems, devised to represent possible improvements to aspects of the situation, with what occurred in real life. In the present evaluations, this was carried out by listing the individual activities of the conceptual models, and asking whether the activities occurred in real life, how the activities were carried out and how they were judged. This is illustrated in Table 3 for one of the activities in the partnership conceptual model and for the monitor and control subsystem.

This process enabled the author to identify specific areas which appeared desirable candidates for change to improve the situation. It became very clear during this process that many of the areas under consideration either lacked monitoring and control systems altogether, or that clear criteria for performance were not in place. Thus, for example, schools were not given criteria against which to judge their success in attracting and retaining Maori and Pasifika students to the project.

Every conceptual model generated or highlighted a range of ideas for improvement to the situation. Some of these are listed in Table 4. Some of the ideas for improvement were thought to be unacceptable within the cultural context of the projects. An example would be to set up ethnicity criteria to determine students' eligibility to enrol in the projects. Such potentially unacceptable ideas were not included in the list of feasible suggestions made to the Ministry of Education.

Soft Systems Methodology includes stages in which suggestions for improvement are intended to be used as a basis for discussion and dialogue with parties involved in the real life situation. Such discussion would be expected to lead to action to improve the real life situation. In the present study this did not happen. The final evaluation report was submitted to the Ministry, and discussed with the evaluators of the other Digital Opportunities projects, with Ministry personnel and with the incoming Digital Opportunities Project Manager.

Activity	Does it exist in real situation	How is it done?	How is it judged?
5. Set up Regular Communication between partners	Minimally	Gisborne schools communicated to some extent through Generation XP coordinator in 2003. Little communication between Auckland schools. Little contact between Business Partners and schools after start up except for some contact with Computer Press Ltd. Contact from schools to Business Partners tended to be to get problems with technology sorted out. Very little use of TKI web site for communication between stakeholders after start up	Business partners stated that they would like more regular communication, rather than working from ' <i>no news is good news</i> ' basis. Some schools would have appreciated closer contact and more interest from BPs in the project.
6. Monitor and Control	No		Does the partnership meet the needs of the partners?

Table 3 Comparison of Activities in the Fruitful Partnership Conceptual Model with those in the Real Situation

DISCUSSION

The author found aspects of the methodology to be particularly valuable in the evaluation. The creation of the Rich Picture proved to be extremely helpful in organising a wide range of quantitative and qualitative data from a variety of sources which included Ministry officials, business partners, schools, potential employers, students and parents. The process of identifying problematic areas, of developing models systems and comparing them with reality had a satisfying rigour. This allowed the evaluator to be reasonably assured that important factors had been considered.

Findings arising from the evaluation research indicated that several of the original goals of the Digital Opportunities were not met. For example, one goal of the Generation XP project was to lower barriers to student achievement and participation especially in relation to technology skills and qualifications; and hence to raise the level of achievement of traditionally low achieving students. This was not achieved. Few students gained MOS passes, and the majority of those which did were academically more able, as judged by traditional criteria. Moreover, the numbers of Maori and Pasifika students passing were extremely low. The Soft Systems Analysis focused on three areas which were perceived to have a bearing on these outcomes. These are the Teach/Learn/Test, the Student Recruitment and the Teacher Training and Professional Development systems outlined in Table 4.

As mentioned above, teachers and principals involved in the project did not perceive them as being true partnerships. Political imperatives led to the project being designed by business partners and the Ministry of Education without reference to the host schools. Schools had only a short period of time in which to decide whether to join a project into which they had had no input. Consequently, they made such comments as feeling '*dumped on*' and that they would be '*fools to turn down*' the free computers and infrastructure.. A key suggestion for improvement in the partnership system related to ongoing communication between the parties.

Another feature of the project was the lack of effective monitoring and control of many key processes. This, and the lack of effective performance criteria became apparent early in the SSM analyses, and suggestions were made as to the design of monitoring and control subsystems for each of the systems modelled.

The cultural analysis made explicit some of the social and political factors underpinning the project. An example is the '*dumped on*' feelings outlined above. The cultural analysis also helped the evaluator to put forward suggestions for change which appeared feasible within the cultural context of the pilot.

Application of the methodology was limited by the lack of provision within the design of the project for effective feedback from the evaluator to the stakeholders. Such feedback is crucial to the full methodology in that it would be expected to lead to dialogue with the aim of taking action to improve the situation.

The bulk of funding for the original suite of Digital Opportunities pilots ceased at the end of 2003, and a new set of projects was initiated with different objectives. The design of the new round projects, covering the period 2005-2007, explicitly addresses some of the shortcomings revealed by the present evaluation and those of the other first round Digital Opportunities projects. (NZ Ministry of Education (2004)) Several of the new round projects have been designed or suggested by schools themselves, and they are to be subjects of ongoing formative evaluation, with a key review stage taking place after a year. These aspects should lead to greater commitment and 'buy in' by participants, and a clearer focus on defined outcomes.

System	Suggestions
Teach/Learn/Test	Establish meaningful performance criteria and monitoring and control procedures within schools
	Careful teacher selection and training. Teachers reflect on performance.
	Tailor environment and courses to appeal to target groups
	Create and provide sufficient new teaching resources relevant to NZ students
	Source appropriate formative assessment materials
	Fund schools to cope with upgrades
Student Recruitment and Selection	Set target levels for numbers of Maori and Pasifika students
	Involve iwi and Pasifika leaders in planning roll outs
	Locate project in marae and community centres as well as schools
	Make courses attractive to target students
Teacher Training and Professional Development	Carefully target training and PD to staff who teach courses
Fruitful Partnerships	Partnerships to involve ongoing cooperation and communication for the duration of the project
	Schools would benefit from greater awareness of the business world
	Communication could happen by progress newsletters from, and business visits to schools
	Digital Opportunities Manager to foster communication
	Establish full partnerships from the start

Table 4. Some Findings and Recommendations from the SSM Analysis.

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